

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



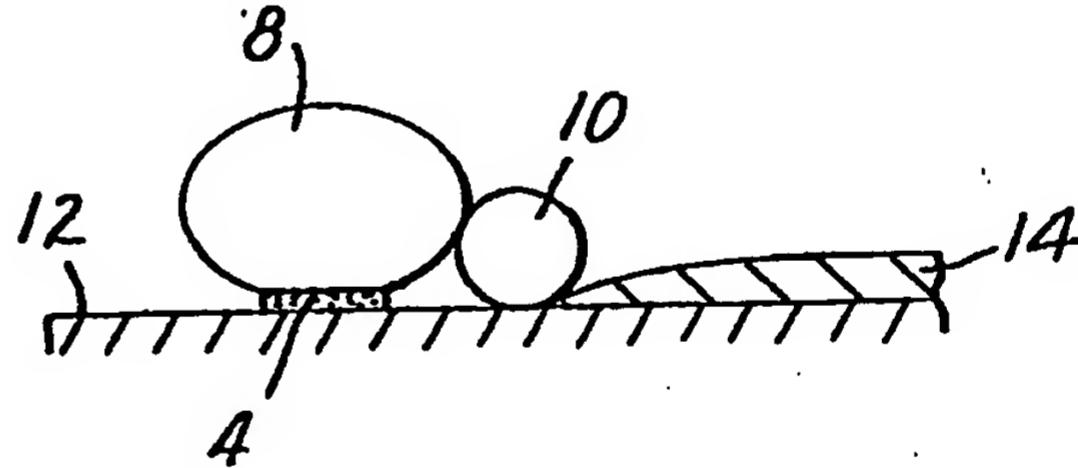
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> :  B05B 15/04	A1	(11) International Publication Number:  WO 99/46056
		(43) International Publication Date: 16 September 1999 (16.09.99)
(21) International Application Number: PCT/US99/05053		(81) Designated States: BR, CA, CN, JP, KR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
(22) International Filing Date: 9 March 1999 (09.03.99)		
(30) Priority Data: 9804967.9 9 March 1998 (09.03.98) GB		Published <i>With international search report.</i>
(71) Applicant (for all designated States except US): MINNESOTA MINING AND MANUFACTURING COMPANY [US/US]; 3M Center, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).		
(72) Inventors; and		
(75) Inventors/Applicants (for US only): BOUIC, Phillip, J. [GB/GB]; 60 Sheffield Road, Sutton Coldfield, West Mid- lands B73 5HD (GB). JOSEPH, Stephen, C., P. [GB/GB]; 33 Laurel Drive, Hartshill, Nr. Nuneaton, Warwickshire CV10 0XP (GB).		
(74) Agents: DOWDALL, Janice, L. et al.; Minnesota Mining and Manufacturing company, Office of Intellectual Property Counsel, P.O. Box 33427, Saint Paul, MN 55133-3427 (US).		

(54) Title: MASKING MATERIALS AND METHOD OF USE

(57) Abstract

A masking material comprises an elongate strip (8) at least partially coated with a layer of a pressure-sensitive adhesive (4), the strip having a curved surface which is convex when the strip is viewed in cross section and is positioned such that when the strip is adhered to a substrate (12) by the layer of pressure-sensitive adhesive a portion of the curved surface overhangs the substrate. The masking material comprises a removable edge portion (10) comprising said portion of the curved surface detachably secured to a remainder of the strip and which may be removed to expose a second curved surface on the remainder of the strip which is convex when viewed in cross section and which is positioned to overhang the substrate. The removable portion and remainder of the strip have different dimensions. Methods for making such masking material are also described.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

**MASKING MATERIALS AND METHOD OF USE****BACKGROUND OF THE INVENTION****TECHNICAL FIELD**

This invention relates to masking materials and to their use during the application  
5 of two or more coating materials to a surface. In particular the invention relates to  
masking materials having a curved edge strip which is removable from the remainder of  
the masking material.

**Description of the Related Art**

10 Masking foam tape comprising a foam substrate having on part of its outer surface  
a layer of pressure-sensitive adhesive is known. A preferred tape has a cross-section  
comprising a curved surface e.g., circular or elliptical, since such masking tape allows a  
"feathered edge" or "soft edge", to be attained during surface coating operations, such as  
painting. The masking tape is positioned such that the curved surface overhangs the  
surface to be painted and thus when the paint is sprayed only paint projected at certain  
15 angles will pass beneath the overhanging portion of the masking tape and the paint  
thickness will be thinner, the edges beneath the overhang allowing a smooth transition to  
the adjacent painted area to be attained. The use of foam allows paint impinging thereon  
to be absorbed preventing it running off the masking material and marring the surface  
being treated. Such masking material is commercially available from 3M United  
20 Kingdom plc under the trade name Soft Edge Masking Foam Tape.

25 Soft edge masking foam tape (SEMFT) may be produced from a foam web by  
compression over a predetermined area with a blunt rotary cutter so that a cold-welded  
seam is formed which secures opposing surfaces of the web to each other at the region of  
the weld, thereby forming a curved surface. An array of circular or elliptical adjacent  
foam strips which are readily separable may be formed by passing a foam web through a  
plurality of parallel blunt rotary cutters causing compression and welding of the foam  
along parallel lines. The production of such foam strips is disclosed in EP-B-0384626.  
Other masking materials comprising foam, which may be cold-welded are disclosed in  
GB-2254811 and GB-2288137.

30 SEMFT is commonly used to mask the inside of door apertures to prevent paint or  
primer spray from contaminating the inside of the vehicle. After applying primer to a car  
panel it is desirable to apply the paint in a manner such that it extends beyond the primer

5

to ensure the primer is completely covered and not left exposed. In such situations the SEMFT may be removed after application of the primer and repositioned. Alternatively, the SEMFT may be gently pushed in an attempt to displace it and position it away from the primer edge. Neither technique is satisfactory since it is labour intensive and not desirable if the primer is still wet.

The invention has been made with this point in mind.

#### SUMMARY OF THE INVENTION

10

15

20

25

30

According to one aspect of the invention there is provided a masking material comprising an elongate strip at least partially coated with a layer of a pressure-sensitive adhesive. The strip has a curved surface which is convex when the strip is viewed in cross-section and is positioned such that when the strip is adhered to a substrate by the layer of pressure-sensitive adhesive a portion of the curved surface overhangs the substrate. The masking material comprises a removable edge portion comprising the portion of the curved surface detachably secured to a remainder of the strip and which may be removed to expose a second curved surface on the remainder of the strip which is convex when viewed in cross-section and which is positioned to overhang the substrate. The removable portion and the remainder of the strip have different dimensions.

According to a second aspect of the invention there is provided a method of coating an area of the surface of a substrate with layers of a first and second coating material. The method comprises the steps of:

(i) Providing a masking material comprising an elongate or endless strip at least partially coated with a layer of a pressure-sensitive adhesive. The strip has a curved surface which is convex when the strip is viewed in cross-section and is positioned such that when the strip is adhered to a substrate by the layer of pressure-sensitive adhesive a portion of the curved surface overhangs the substrate. The masking material comprises a removable edge portion comprising the portion of the curved surface detachably secured to the remainder of the strip and which may be removed to expose a second curved surface on the remainder of the strip which is convex when viewed in cross-section and which is positioned to overhang the substrate. The removable portion and the remainder of the strip have different dimensions.

(ii) Applying the masking material to the substrate such that the curved surface is adjacent the edge of the area to be coated.

(iii) Applying the first coating material over the area of the surface up to the masking material.

(iv) Detaching and removing the removable portion of the masking material.

5 (v) Applying the second coating material over the first coating material and up to the remainder of the masking material.

The masking material of the invention is simple and effective to use. The elongate strip is applied to the surface in the normal manner with the curved surface adjacent the edge of the area of the surface to be coated. After application of a first coating material, e.g., primer, the curved surface is readily removable to expose a second curved surface 10 slightly extending the area to be coated such that the second coating will completely overlap the first coating while ensuring a feathered edge is obtained. Thus, repositioning of the masking material between successive coating operations is unnecessary.

15 The masking material is preferably made of foam and may conveniently be produced by cold-welding foam web by the techniques disclosed in EP-0384626.

Polyurethane foam is preferred for use in the cold-welded embodiments of the invention. The foam preferably has a density of about 26Kg /m<sup>3</sup> . A preferred cold-weldable foam is commercially available from Caligen Foam Limited under the trade designation "Grade 4273A".

20 The removable edge of the masking material may be achieved in various ways.

In one embodiment, the elongate strip may be formed with a circular or elliptical cross-section and a layer of foam or similar material releasably secured to and following the contour of the curved surface extends as a strip along the length of the masking material to form a removable edge. The removable strip may be secured by pressure-sensitive adhesive, welding or a combination thereof.

25 Such a masking material may be made by a method which comprises the steps of:

(a) providing a first cold-weldable foam web;

(b) applying at least two parallel stripes of a pressure-sensitive adhesive to a surface of the foam web;

30 (c) applying a second cold-weldable foam web having a thickness less than that of the first web to the first web such that the second web overlaps but does not completely cover the adjacent parallel stripes of pressure-sensitive adhesive;

(d) compressing the first and second cold-weldable webs midway between the adjacent stripes of pressure-sensitive adhesive using a blunt rotary cutter so that a cold-welded seam is formed which secures the two webs to each other at the region of the weld thereby forming a curved surface; and

5 (e) compressing the first web using a blunt rotary cutter so that a cold-weld is formed which secures opposing surfaces of the web to each other in the region of the weld thereby forming a curved surface, said web(s) being compressed along at least three parallel lines to form at least two cords of circular or oval cross-section.

The elongate strip may comprise a plurality of removable edge portions in the form 10 of layers of foam following the contour of the curved surface and extending along the length of the strip. Such masking materials may be made by a method comprising the steps of:

(a) providing a first cold-weldable foam web;  
15 (b) providing at least two second cold-weldable foam webs having a thickness and width smaller than that of the first cold-weldable foam web;

(c) adhering said second webs to a surface of the first web with pressure-sensitive adhesive to form parallel strips of said second webs;

20 (d) compressing said first and second cold-weldable webs using a blunt rotary cutter so that a cold-welded seam is formed which secures the first and second webs together at the region of the weld thereby forming a curved surface, said webs being compressed along at least two parallel lines along the longitudinal axis of the second webs to form at least one cord of circular or oval cross-section; and

25 (e) applying a pressure-sensitive adhesive to the surface of the first web in the region between the second webs prior to cold-welding or to the surface of the first web of the cord between the second webs after cold-welding.

In a further embodiment the masking material may comprise a primary cord of circular or elliptical cross-section having a strip of pressure-sensitive adhesive coated thereon and a secondary cord parallel to the primary cord releasably secured thereto. The secondary cord may readily be formed simultaneously with the primary cord from a foam web by cold-welding.

30 Such a masking material may be made by a method comprising the steps of:

(a) providing a cold-weldable foam web;

5 (b) compressing said foam web using at least one blunt rotary cutter so that a cold-welded seam is formed which secures opposing surfaces of the web to each other at the region of the weld, thereby forming a curved surface, said web being compressed along at least three parallel lines to form at least two cords having a pair of longitudinal weld seams and a circular or oval cross section, two cords being releasably secured by a common weld and having different dimensions; and

10 (c) applying a stripe of pressure-sensitive adhesive to the web in the region of the cord having the larger dimension prior to cold-welding or to the cord of larger dimension after cold-welding.

15 In a further embodiment of the invention the masking material may be in the form of an endless elongate strip e.g., a closed curve, such as a circle or ellipse or other shape, e.g., square, hexagon etc. A concentric array of such strips may be formed e.g., by compressing and cold-welding foam, adjacent strips being separable from each other by tearing the weld. Examples of such an array are disclosed in GB-2254811. In use, the user removes sufficient strips which define an aperture having the area of the surface to be coated and the masking material is applied to the surface. After the first coating e.g., primer has been applied, the inner strip is removed and the second coating applied overlapping the first coating.

20

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings in which:

25 Figures 1a and b illustrate the production of a masking material in accordance with one embodiment of the invention;

Figures 2a and b illustrate the use of the masking material of Figure 1;

Figures 3a and b illustrate the production of a masking material in accordance with a second embodiment of the invention;

Figures 4a and b illustrate the use of the masking material of Figure 3;

30 Figures 5a and b illustrate the production of a further masking material in accordance with the invention; and

Figure 6 illustrates masking material for use in the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figures 1a and b illustrate the production of a masking material in accordance with one embodiment of the invention. Figure 1a shows, in cross-section, a portion of a foam web (2) on which is coated a stripe of pressure-sensitive adhesive (4). The foam web is passed through a multi-slitter fitted with crush cutter blades (6). Three crush cutter blades (6) are shown which are spaced an appropriate distance apart to form a primary cord (8) and a secondary cord (10). A repeating arrangement of such cutter blades may extend across the full width of the web to produce a multiple array of masking strips.

The crush cutter blades compress the foam web and form a cold-weld which holds the foam in the curved configuration shown in Figure 1b. A primary cord (8) having the stripe of pressure-sensitive adhesive (4) is formed joined to a secondary cord (10) by a common cold-weld. The secondary cord (10) is readily separable from the primary cord (8) by tearing along the weld.

Figures 2a and b illustrate the use of the masking material. The masking material is secured to a surface (12) to be coated by the pressure-sensitive adhesive stripe (4). The masking material is positioned such that the secondary cord (10) contacts the surface (12) and is adjacent the area to be coated. A first coating (14) (shown in exaggerated thickness) is applied. Typically the first coating (14) will be a primer. It will be noted that the coating (14) extends under the curvature of the secondary cord (10) resulting in a tapered or feathered edge to the coating (14).

The secondary cord (10) is removed by tearing along the cold-weld. The primary cord (8) remains in position and a second coating (16) (shown in exaggerated thickness) is applied over the first coating (14). The second coating (16) extends over the edge of the coating (14) and under the overhanging curvature of the primary cord (8) thereby assuring that none of the coating (14) is exposed and providing a feathered edge to the coating (16). Thereafter, the primary cord (8) is removed.

The dimensions of the primary and secondary cords may be varied by suitable selection of the thickness of the foam web and spacing of the crushed cutter blades. Suitable masking materials have been produced from a foam web having a thickness of about 15mm to produce a substantially cylindrical primary cord having a diameter of approximately 13mm. Secondary cords of approximately 3, 6 and 7mm attached to the primary cord have been formed by suitable spacing of the crushed cutter blades.

Figures 3a and b illustrate the production of a masking material in accordance with a second embodiment of the invention. A foam web (20) is coated with two stripes of pressure-sensitive adhesive (22, 24) and a second thinner foam web (25) e.g., having a thickness of 2 to 5mm, is placed such that it overlaps, but does not completely cover, the adhesive strips (22, 24). The composite web is fed into a multi-slitter fitted with crushed cutter blades the positions of which are shown at 26. The crush cutter blades compress the foam web forming cold-welds resulting in the production of two separate masking strips (28). Each masking strip (28) comprises a substantially cylindrical portion (30) formed from the foam web (20), an adhesive stripe (22, 24) and a removable edge portion (32) formed from the foam web (25) which is secured to the cylindrical portion (30) by the adhesive stripe (22, 24) and a cold-weld. The removable edge (32) follows the cylindrical contour of the core (30).

Figures 4a and b illustrate use of the masking material (28). The masking material is positioned on a surface (12) to be coated and secured by the pressure-sensitive adhesive stripe (22, or 24, not shown). The masking material is positioned such that the removable edge (32) is adjacent the edge of the area to be coated. A first coating material (14), e.g., primer, is applied, some of which extends beneath the overhang of the curve of the removable edge (32) to provide a feathered edge to the coating. Thereafter, the removable edge (32) is stripped from the core (30) without displacement of the core thereby exposing the curved surface of the core adjacent the edge of the area to be coated. A second coating (16) is applied over the first coating. The second coating (16) completely overlays the first coating and extends under the overhang of the curve of the core (30) thereby providing a feathered edge to the second coating. Thereafter, the masking material is removed.

Figures 5a and b illustrate the production of a masking material similar to that disclosed in Figures 3 and 4 but having two removable edges. The masking material is formed from a foam web (31) on which two thin foam strips (33) are adhered by a pressure-sensitive adhesive or double sided pressure sensitive adhesive tape (not shown). The two foam strips (33) are separated by a gap (34) on which a stripe of pressure-sensitive adhesive is applied either before or after cold-welding. The composite web is fed into a multi-slitter fitted with crusher blades (36) which compress the foam and form a cold-weld. The resultant masking material is shown in Figure 5b and comprises an array

of masking material each comprising a central core (38) and a pair of removable edges (40). Adjacent masking strips are adhered to each other by the cold-weld but are readily separable. Each masking strip may be used in the manner described with reference to Figures 4a and b.

5       Figure 6 of the accompanying drawings illustrates a variable size painting mask which is made by die stamping a foam web e.g., 5mm thick, in a manner such that the die steel does not cut all the way through the foam but the foam is marked with a series of concentric cold-welds. The overall masking material may be in the region of 1 metre square and comprise a plurality of concentric welds (50a to 50d) defining annular segments (52a to 52d). In use, one or more segments of the mask large enough to completely reveal the area to be painted is removed e.g., segment (52a), and the mask applied to the surface and held in place by a layer of adhesive (not shown). A first coating material is applied, the mask allowing formation of a feathered edge due to the curvature caused by the cold-weld. The inner segment of the mask e.g., segment (52b) is then removed by tearing the cold-weld thereby exposing a further curved surface. A second coating material is applied over the first coat, the curve of the remaining masking material causing a feathering effect at the edge of the top layer. It will be appreciated that a variety of shapes other than circular may be employed for the variable size painting mask.

10

15

CLAIMS

What is claimed is:

1. A masking material comprising an elongate strip at least partially coated with a layer of a pressure-sensitive adhesive, the strip having a curved surface which is convex when the strip is viewed in cross-section and is positioned such that when the strip is adhered to a substrate by the layer of pressure-sensitive adhesive a portion of the curved surface overhangs the substrate, wherein the masking material comprises a removable edge portion comprising said portion of the curved surface detachably secured to a remainder of the strip which may be removed to expose a second curved surface on the remainder of the strip which is convex when viewed in cross-section and which is positioned to overhang the substrate, said removable portion and the remainder of the strip having different dimensions.
2. A masking material as claimed in Claim 1 in which the elongate strip is formed of a cold-weldable foam and has at least one cold-welded seam along its longitudinal length which maintains the configuration of the curved surface.
3. A masking material as claimed in Claim 1 or Claim 2 in which the elongate strip comprises a pair of cold-welded seams and has a substantially oval or circular cross-section.
- 20 4. A masking material as claimed in any preceding claim in which the removable edge portion comprises a foam cord of substantially oval or circular cross-section detachably secured to the elongate strip.
5. A masking material as claimed in Claim 4 in which the foam cord and elongate strip are joined by a cold-weld.
- 25 6. A masking material as claimed in any one of Claims 1 to 3 in which the removable edge portion comprises a foam strip detachably secured to a curved surface of the elongate strip.
7. A masking material as claimed in Claim 6 in which the foam strip is detachably secured with pressure-sensitive adhesive.
- 30 8. A masking material as claimed in Claim 6 or Claim 7 in which the edge portion is detachably secured by a cold-weld to the remainder of the strip.

9. A masking material as claimed in any one of Claims 6 to 8 comprising a plurality of removable edge portions.
10. An array comprising a plurality of adjacent strips of masking material as defined in any preceding claim in which adjacent strips are releasably joined to each other by longitudinal welded seams.  
5
11. A method of coating an area of the surface of a substrate with layers of a first and second coating material which comprises the steps of:
  - (i) providing a masking material comprising an elongate or endless strip at least partially coated with a layer of a pressure-sensitive adhesive, the strip having a curved surface which is convex when the strip is viewed in cross-section and is positioned such that when the strip is adhered to a substrate by the layer of pressure-sensitive adhesive a portion of the curved surface overhangs the substrate, in which the masking material comprises a removable edge portion comprising said portion of the curved surface detachably secured to the remainder of the strip and which may be removed to expose a second curved surface on the remainder of the strip which is convex when viewed in cross-section and which is positioned to overhang the substrate, said removable portion and the remainder of the strip having different dimensions;  
10
  - (ii) applying said masking material to the substrate such that the curved surface is adjacent the edge of the area to be coated;
  - (iii) applying the first coating material over said area of the surface up to said masking material;  
15
  - (iv) detaching and removing said removable portion of the masking material; and
  - (v) applying the second coating material over the first coating material and up to the remainder of the masking material.  
20
12. A method as claimed in Claim 11 in which the masking material is as defined in any one of Claims 1 to 9.  
25
13. A method as claimed in Claim 11 or Claim 12 in which the first coating material is a primer and the second coating material is a paint.
14. A method as claimed in any one of Claims 11 to 13 in which the surface comprises an automobile surface.  
30

15. A method of making a masking material as defined in Claim 5 which comprises the steps of:

(a) providing a cold-weldable foam web;  
(b) compressing said foam web using at least one a blunt rotary cutter so that a cold-welded seam is formed which secures opposing surfaces of the web to each other at the region of the weld, thereby forming a curved surface, said web being compressed along at least three parallel lines to form at least two cords having a pair of longitudinal weld seams and a circular or oval cross section, two cords being releasably secured by a common weld and having different dimensions; and

(c) applying a stripe of pressure-sensitive adhesive to the web in the region of the cord having the larger dimension prior to cold-welding or to the cord of larger dimension after cold-welding.

16. A method of making a masking material as defined in Claim 6 which comprises the steps of:

(a) providing a first cold-weldable foam web;  
(b) applying at least two parallel stripes of a pressure-sensitive adhesive to a surface of the foam web;  
(c) applying a second cold-weldable foam web having a thickness less than that of the first web to the first web such that the second web overlaps but does not completely cover adjacent parallel stripes of pressure-sensitive adhesive;  
(d) compressing the first and second cold-weldable webs midway between the adjacent stripes of pressure-sensitive adhesive using a blunt rotary cutter so that a cold-welded seam is formed which secures the two webs to each other at the region of the weld thereby forming a curved surface; and

(e) compressing the first web using a blunt rotary cutter so that a cold-weld is formed which secures opposing surfaces of the web to each other in the region of the weld thereby forming a cured surface, said web(s) being compressed along at least three parallel lines to form at least two cords of circular or oval cross-section.

17. A method of making a masking material defined in Claim 9 which comprises the steps of:

(a) providing a first cold-weldable foam web;

(b) providing at least two second cold-weldable foam webs having a thickness and width smaller than that of the first cold-weldable foam web;

(c) adhering said second webs to a surface of the first web with pressure-sensitive adhesive to form parallel strips of said second webs;

5 (d) compressing said first and second cold-weldable webs using a blunt rotary cutter so that a cold-welded seam is formed which secures the first and second webs together at the region of the weld thereby forming a curved surface, said webs being compressed along at least two parallel lines along the longitudinal axis of the second webs to form at least one cord of circular or oval cross-section; and

10 (e) applying a pressure-sensitive adhesive to the surface of the first web in the region between the second webs prior to cold-welding or to the surface of the first web of the cord between the second webs after cold-welding.

18. A masking material according to Claim 1 in which said elongate strip is endless.

19. A masking material according to claim 18 formed of a cold-weldable foam and 15 comprising a plurality of concentric cold-welded seams defining a plurality of concentric endless strips, each strip being detachably secured to an adjacent strip by a cold-welded seam.

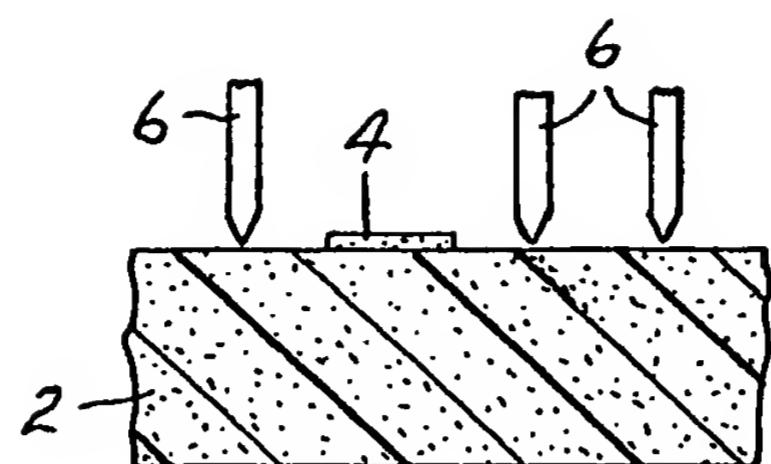


FIG. 1A

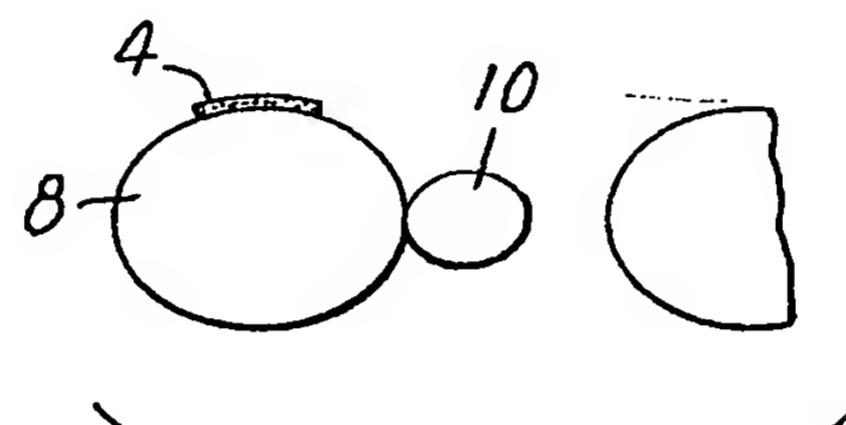


FIG. 1B

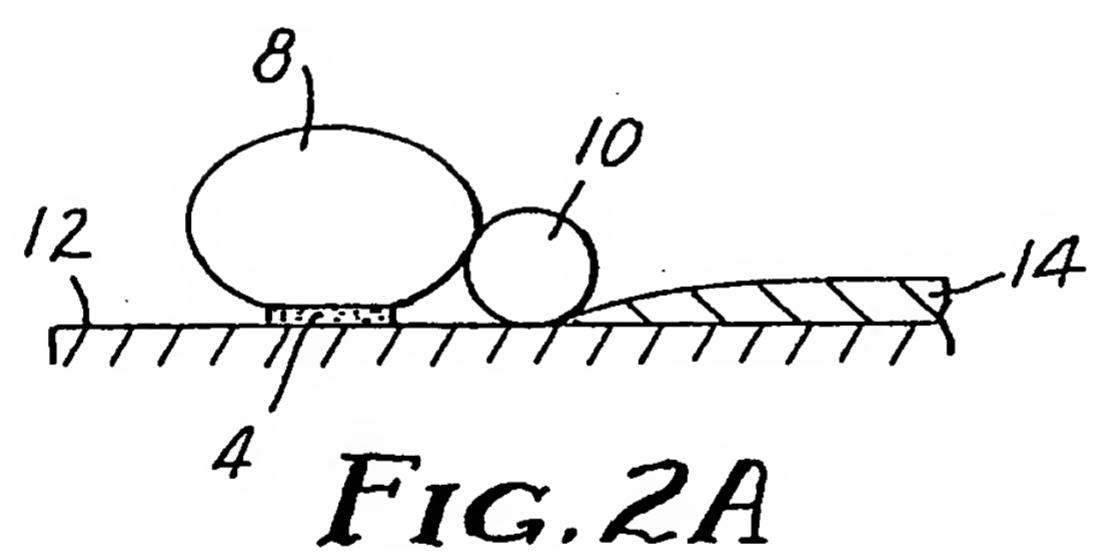


FIG. 2A

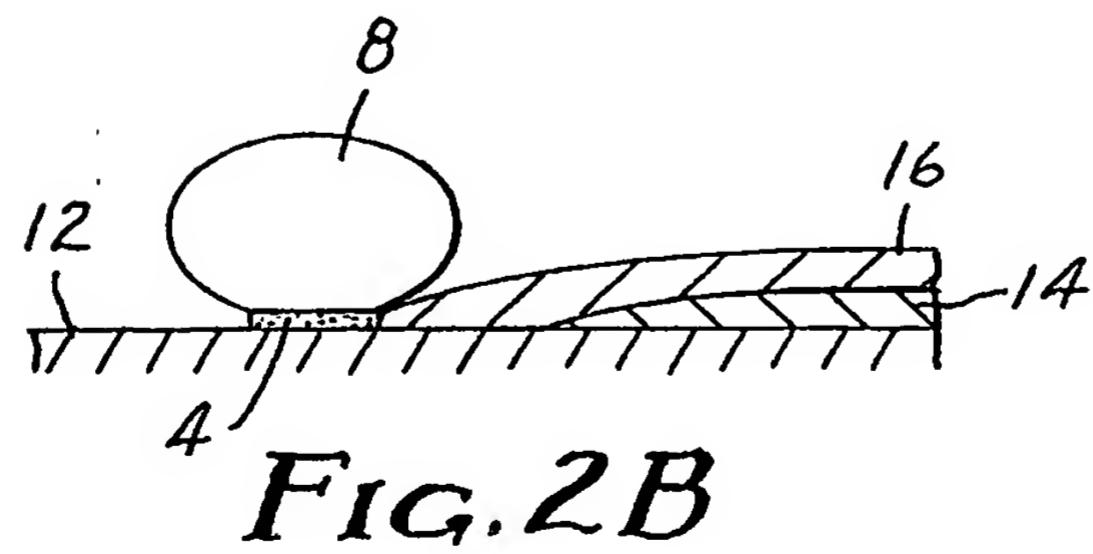


FIG. 2B

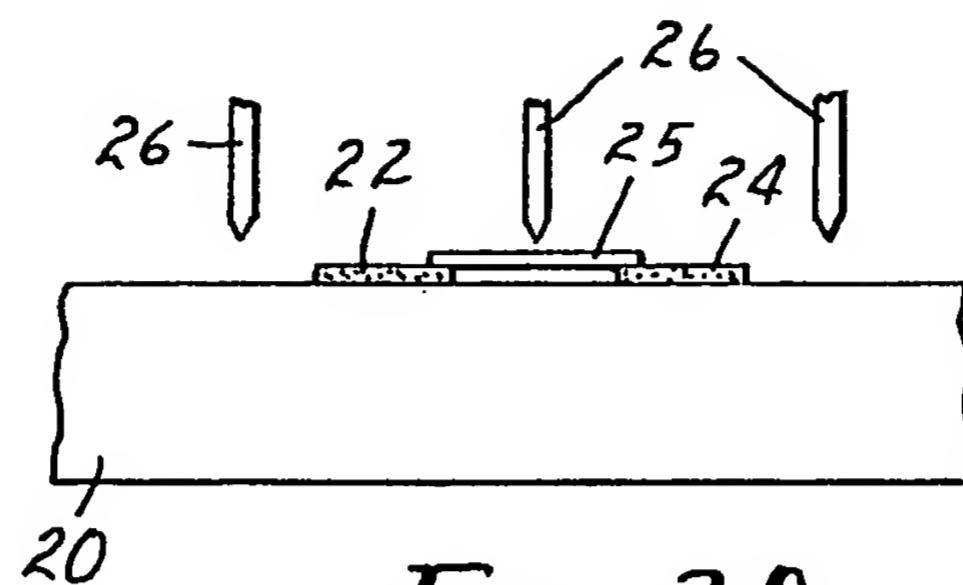


FIG. 3A

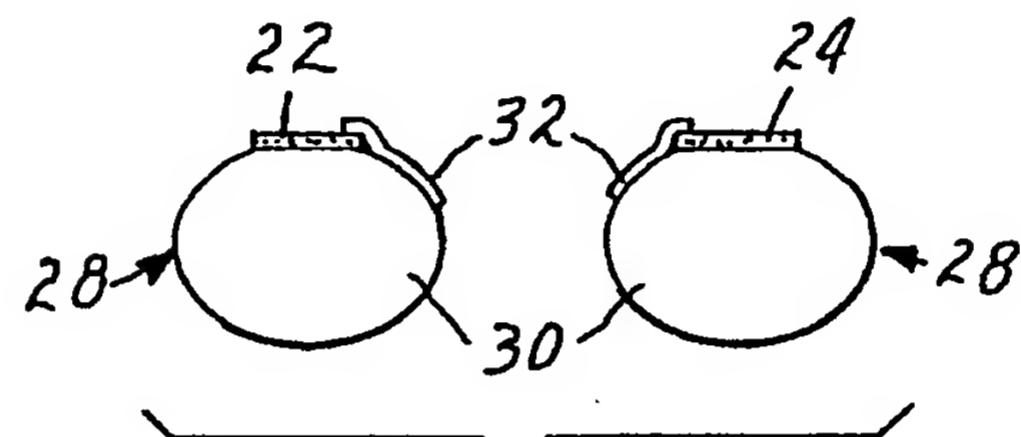


FIG. 3B

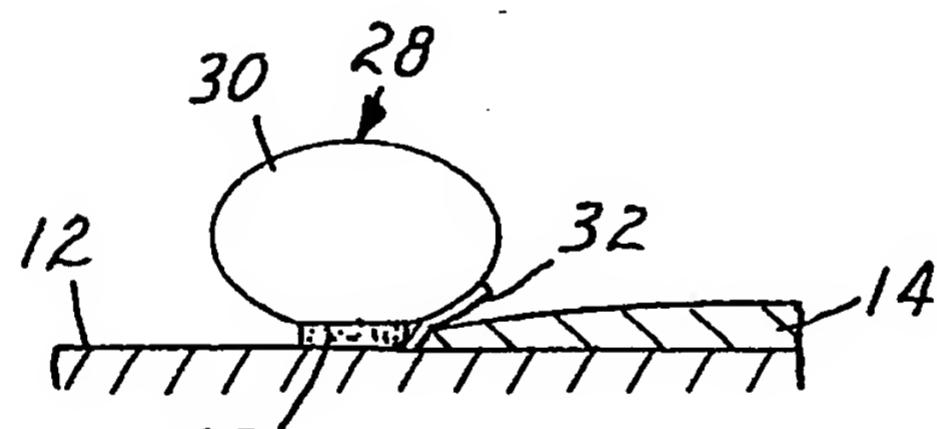


FIG. 4A

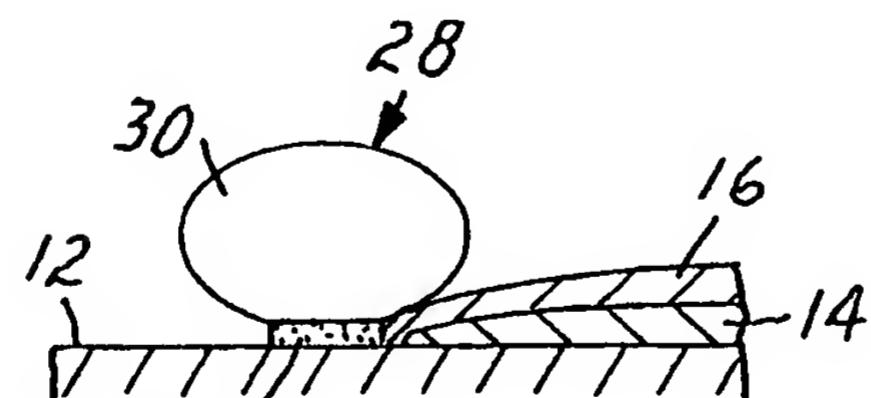


FIG. 4B

3 / 3

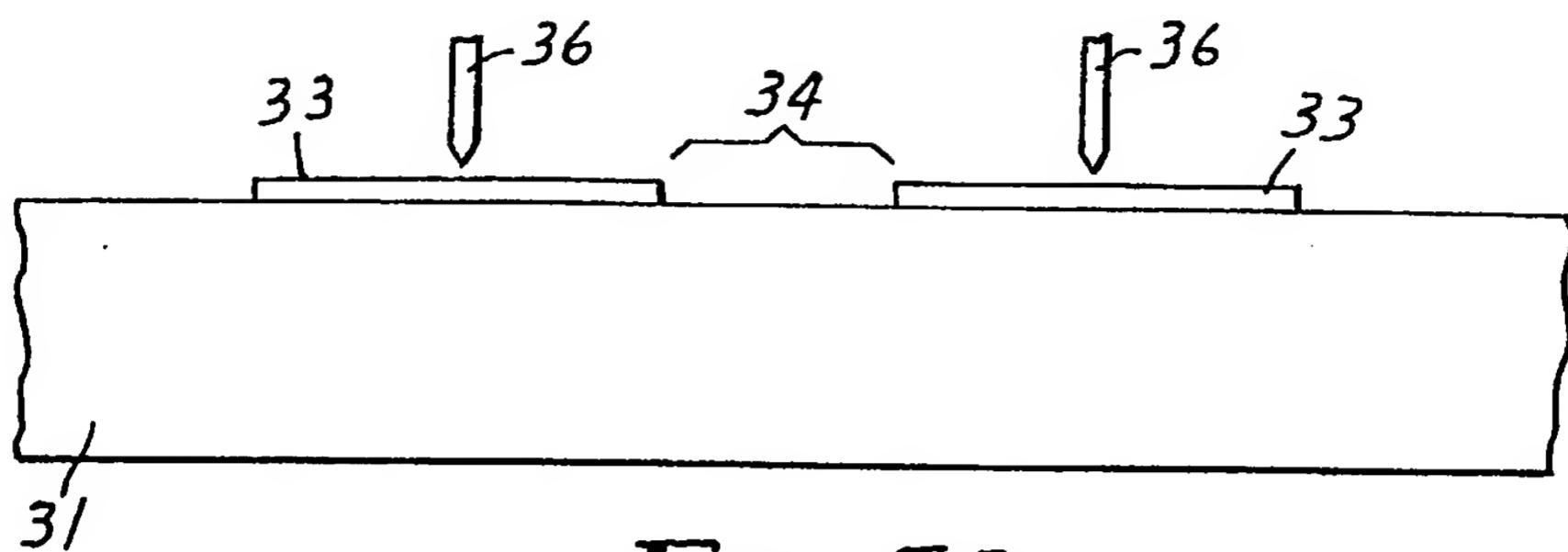


FIG. 5A

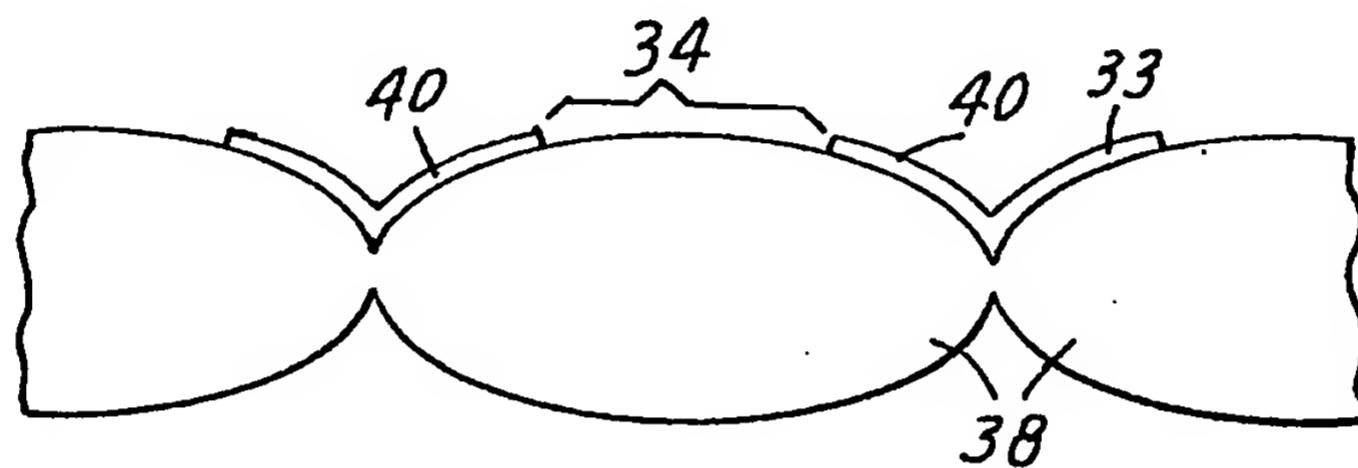


FIG. 5B

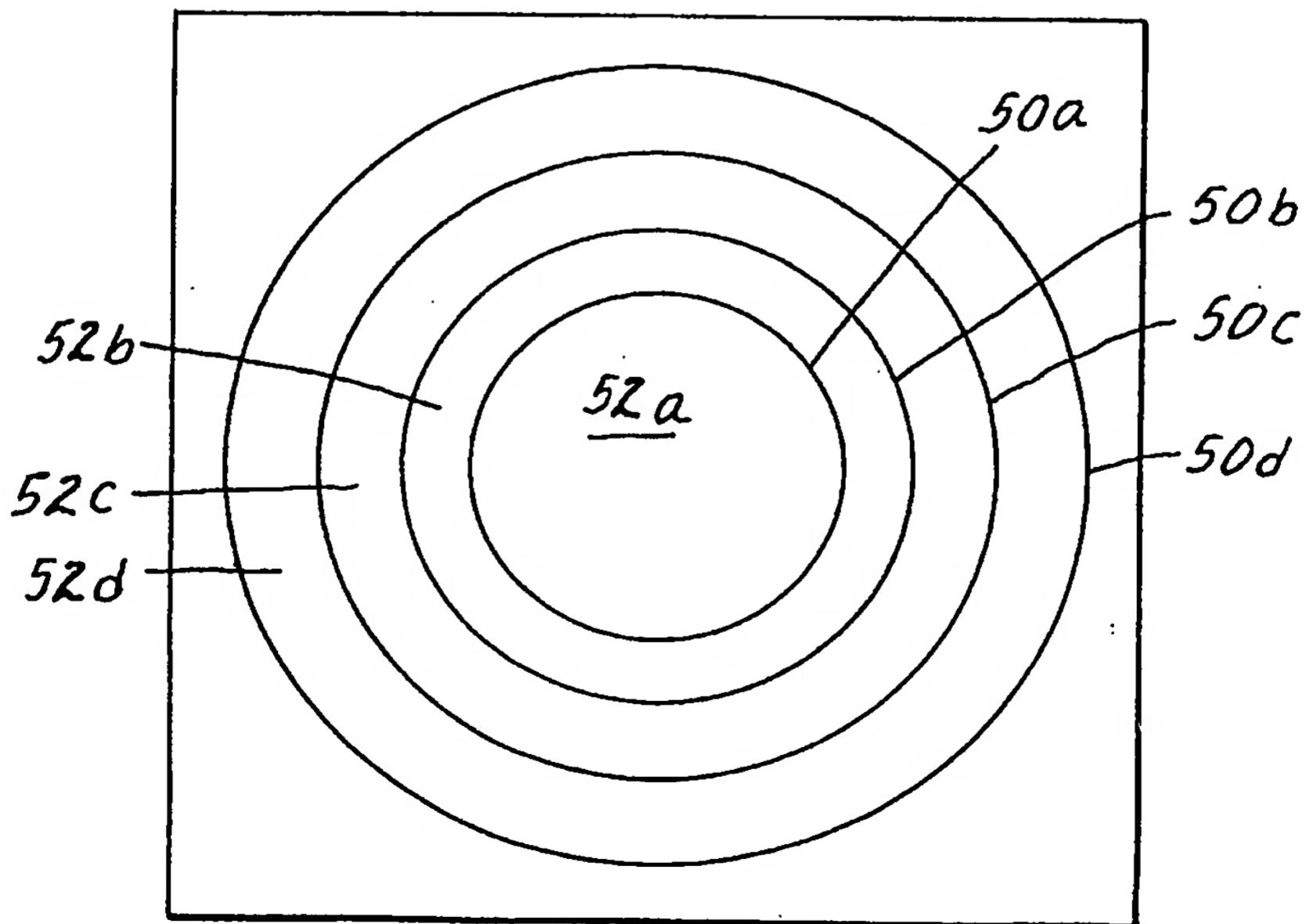


FIG. 6

# INTERNATIONAL SEARCH REPORT

Int'l. Appl. No.

PCT/US 99/05053

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 B05B15/04

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 795 356 A (VOSS CHEMIE) 17 September 1997 see claims 1,16 see abstract; figures 1,5	1,4,6,7, 9,18
A	---	11,19
X	WO 95 21700 A (SPEEDARRIVE PROJECTS LTD ;HILLS ROBIN WILLIAM (GB)) 17 August 1995 see page 1, line 30 - page 2, line 17 see page 5, line 9 - line 21 see abstract; figures 4,7E,7A	1,4,6,7, 18
A	---	2,3,5, 8-11,19
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

21 May 1999

Date of mailing of the international search report

07/06/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Brosio, A

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/05053

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 384 626 A (MINNESOTA MINING &amp; MFG)  29 August 1990  cited in the application  see column 3, line 10 - line 54  see column 4, line 24 - line 42  see abstract; figures 1A,1B,1C,4-6  -----</p>	1,11
A	<p>WO 92 18252 A (MINNESOTA MINING &amp; MFG)  29 October 1992  see page 3, line 12 - line 29  see figures 1,2  -----</p>	1,11

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. onal Application No

PCT/US 99/05053

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP 0795356	A 17-09-1997	NONE		
WO 9521700	A 17-08-1995	AU 695889 B		27-08-1998
		AU 1667995 A		29-08-1995
		CA 2183162 A		17-08-1995
		EP 0745000 A		04-12-1996
		JP 9508576 T		02-09-1997
EP 0384626	A 29-08-1990	CA 2009721 A		20-08-1990
		DE 9007753 U		23-03-1995
		DE 9007759 U		23-03-1995
		DE 69018854 D		01-06-1995
		DE 69018854 T		12-10-1995
		JP 2261634 A		24-10-1990
		KR 145068 B		15-07-1998
		MX 170502 B		26-08-1993
		US 4996092 A		26-02-1991
WO 9218252	A 29-10-1992	GB 2254811 A		21-10-1992
		AU 663503 B		12-10-1995
		AU 1872692 A		17-11-1992
		BR 9205913 A		27-09-1994
		CA 2107575 A		20-10-1992
		DE 69225476 D		18-06-1998
		DE 69225476 T		07-01-1999
		EP 0580804 A		02-02-1994
		ES 2115675 T		01-07-1998
		JP 6507572 T		01-09-1994
		US 5413637 A		09-05-1995